

CLAIMS

What is claimed is:

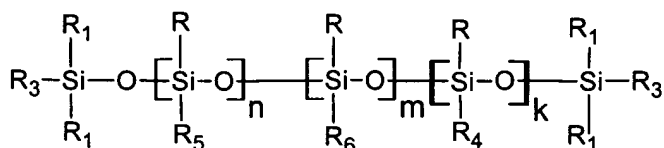
1. An electrochemical device, comprising:
 - 5 an electrolyte including a polysiloxane having a backbone, the backbone including one or more terminal silicons linked to at least one side chain that includes a poly(alkylene oxide) moiety or a carbonate moiety.
2. The device of claim 1, wherein the at least one side chain includes the carbonate moiety.
3. The device of claim 2, wherein the carbonate moiety is a cyclic carbonate moiety.
- 10 4. The device of claim 1, wherein the at least one side chain includes the poly(alkylene oxide) moiety.
5. The device of claim 4, wherein an organic spacer is positioned between the poly(alkylene oxide) moiety and the backbone.
6. The device of claim 1, wherein each of the terminal silicons are linked to at least one side
 - 15 chain that includes the poly(alkylene oxide) moiety.
7. The device of claim 1, wherein each silicon on the polysiloxane backbone is linked to at least one side chain that includes the poly(alkylene oxide) moiety.
8. The device of claim 1, wherein a terminal silicon is linked to at least one side chain that includes the poly(alkylene oxide) moiety and another terminal silicon is linked to at least one
 - 20 side chain that includes the carbonate moiety.
9. The device of claim 1, wherein each terminal silicon is linked to at least one side chain that includes the carbonate moiety.

10. The device of claim 9, wherein each non-terminal silicon is linked to at least one side chain that includes a poly(alkylene oxide) moiety.

11. The device of claim 1, wherein one or more of the silicons are linked to a cross link that links the backbone of the polysiloxane to a backbone of another polysiloxane.

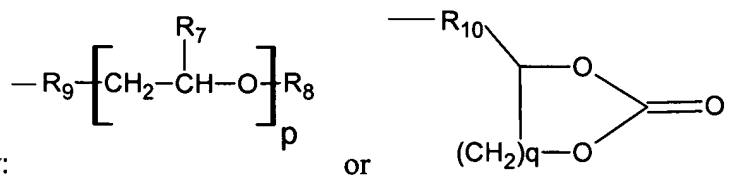
5 12. The device of claim 1, wherein the at least one side chain includes an oxygen linked to a silicon on the backbone.

13. The device of claim 1, wherein the polysiloxane is represented by:



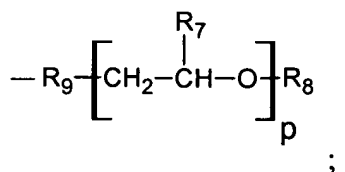
where R is alkyl or aryl; R₁ is alkyl or aryl;

10 R₃ is represented by:

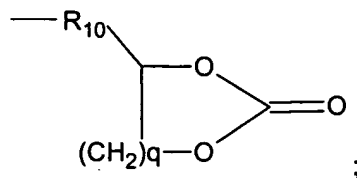


R₄ is a cross link that links the polysiloxane backbone to another polysiloxane backbone;

R₅ is represented by:



R₆ is represented by:

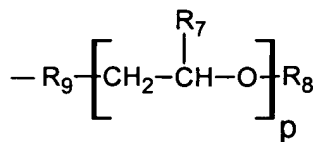


15 R₇ is hydrogen; alkyl or aryl; R₈ is alkyl or aryl; R₉ is oxygen or an organic spacer; R₁₀ is an oxygen or an organic spacer; k is greater than or equal to 0; p is 3 to 20; q is 1 to 2; m is greater than or equal to 0 and n is 2 to 25.

14. The device of claim 13, wherein a ratio of n:m is in a range of 10:1 to 100:1.

15. The device of claim 13, wherein k is greater than 0 and a ratio of the number of cross links to (m+n) is in a range of 1:6 to 1:70.

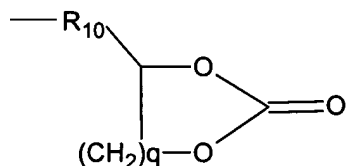
16. The device of claim 13, wherein at least one R₃ is represented



by:

5 17. The device of claim 16, wherein R₉ is an organic spacer.

18. The device of claim 13, wherein at least one R₃ is represented by:



19. The device of claim 13, wherein at least one R₃ has a different structure from another R₃.

20. The device of claim 13, wherein each R₃ has a different structure from each R₅ and from
10 each R₆.

21. The device of claim 1, wherein the average molecular weight for the polysiloxane is less than or equal to 3000 g/mole.

22. The device of claim 1, wherein the electrolyte includes lithium ions, and wherein a
15 [O]/[Li] ratio is 5 to 50, [O] being the molar concentration of the active oxygens in the electrolyte and [Li] being the molar concentration of the lithium ions in the electrolyte.

23. The device of claim 1, wherein the electrolyte is a liquid.

24. The device of claim 1, wherein the electrolyte is a solid.

25. The device of claim 1, wherein the polysiloxane is cross linked.

26. The device of claim 1, wherein the polysiloxane is a member of an interpenetrating network.
27. The device of claim 1, wherein the electrolyte has a conductivity better than 1.0×10^{-4} S/cm at 25 °C.
- 5 28. A precursor solution for use in generating an electrochemical cell electrolyte, comprising:
a polysiloxane precursor having a backbone with terminal silicons that are each linked to a hydrogen; and
a side-chain precursor that includes a poly(alkylene oxide) moiety or a carbonate moiety.
- 10 29. The solution of claim 28, wherein the side chain precursor includes a poly(alkylene oxide) moiety.
30. The solution of claim 28, wherein the side chain precursor includes an allyl terminated spacer precursor linked to the poly(alkylene oxide) moiety.
31. The solution of claim 28, wherein the side chain precursor includes an –OH terminated spacer precursor linked to the poly(alkylene oxide) moiety.
- 15 32. The solution of claim 28, further comprising:
a second side chain precursor, the second side chain precursor including a carbonate moiety.
33. The solution of claim 32, wherein the second side chain precursor includes an allyl terminated spacer precursor linked to the carbonate moiety.
- 20 34. The solution of claim 32, wherein the second side chain precursor includes an -OH terminated spacer precursor linked to the carbonate moiety
35. The solution of claim 32, wherein the carbonate is a cyclic carbonate.

36. A method of forming an electrolyte suitable for use in an electrochemical device, comprising:

combining components of a precursor solution, the components including a polysiloxane precursor having a backbone with terminal silicons that are each linked to a hydrogen and a side-chain precursor that includes a poly(alkylene oxide) moiety or a carbonate moiety.

37. The method of claim 36, wherein the side chain precursor includes a poly(alkylene oxide) moiety.

38. The method of claim 37, wherein the side chain precursor includes an allyl terminated spacer precursor linked to the poly(alkylene oxide) moiety.

39. The solution of claim 37, wherein the side chain precursor includes an –OH terminated spacer precursor linked to the poly(alkylene oxide) moiety.

40. The method of claim 37, further comprising:
a second side chain precursor, the second side chain precursor including a carbonate moiety.

41. The method of claim 36, wherein the carbonate is a cyclic carbonate.

42. The method of claim 36, further comprising:
reacting the components of the precursor solution so as to form a polysiloxane having one or more terminal silicons that are each linked to at least one side chain that includes a poly(alkylene oxide) moiety or a carbonate moiety.

43. The method of claim 36, further comprising:
employing a ring opening polymerization to generate the polysiloxane precursor.

44. The method of claim 43, wherein employing the ring opening polymerization includes forming a solution having a cyclic polysiloxane and a molecular weight controller, the molecular weight controller serving as a source of ions that terminate the polymerization reaction.

45. The method of claim 44, wherein the backbone of the cyclic polysiloxane includes silicons linked to hydrogens.
46. The method of claim 44, wherein the molecular weight controller includes at least two silicons linked to a hydrogen.
- 5 47. The method of claim 44, wherein the molecular weight controller includes a disiloxane moiety.
48. A method of forming a polysiloxane precursor suitable for use in the generating an electrolyte, comprising:
employing a ring opening polymerization to generate a polysiloxane precursor with a
10 backbone having one or more terminal silicons that are each linked to a hydrogen.
49. The method of claim 48, wherein employing the ring opening polymerization includes forming a solution having a cyclic polysiloxane and a molecular weight controller, the molecular weight controller serving as a source of ions that terminate the polymerization reaction.
50. The method of claim 48, wherein the backbone of the cyclic polysiloxane includes
15 silicons linked to hydrogens.
51. The method of claim 48, wherein each of the silicons in the backbone of the cyclic polysiloxane is linked to at least one hydrogen.
52. The method of claim 48, wherein the molecular weight controller includes at least one silicon linked to a hydrogen.
- 20 53. The method of claim 48, wherein the molecular weight controller includes a disiloxane moiety.
54. The method of claim 48, wherein the molecular weight controller includes tetramethyl disiloxane.